KULLIYYAH OF ENGINEERING
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

TO HANDPHONE BURGLAR ALARM USING PIC 16F877A MICROCONTROLLER

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ABSTRACT

This project is designed to improve the home safety and the conventional alarm system today. The project is not only to detect any intrusion and turn on the bell alarm but also tell the owners by calling their handphone. The main focus of this project is to generate the DTMF (Dual Tone Multi Frequency) tones using a cheap PIC Microcontroller and the corresponding circuit. The theory of the DTMF tones generation is discussed in quite detail with suitable graphs shown in this report. This project is already done successfully since it can generate the DTMF tones and able to make a call to a specific handphone number.

ACKNOWLEDGEMENT

All praise be to Allah for His Guidance and Benevolence that has given a success for me to complete this project.

I would like to sincerely thank Tengku Yahya Tengku Hassan as my honorable supervisor and was very helpful to me in his expertise and experiences for guiding me through this project.

Also I would like to thank bro. Romli b Sidek as a staff at switching unit of TM Tanah Merah that always ready to share his experience whenever I ask any question.

May Allah bless each one of us.

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CHAPTER 1

INTRODUCTION

1.1 Background of the Project

This project is aimed at designing an alarm system that able to make a call to a specific handphone when there are intruders. The increasing of the number of the stealing and house breaking cases especially when the people are not at home, need a system that can tell them if the cases happen. By attaching the system to an available fix telephone line, a call can be made to the owner cheaply and easily without need to an extra expensive telecommunication system. The project which powered by 9V battery is made of a cheap PIC Microcontroller, Digital to Analog Converter (DAC), modified home telephone and switches as sensors. The project that would minimize the stealing cases either at homes, shops and offices will be a great deal and desirable for the potential buyers.

1.2 Objectives

- To study the fix telephone line and call system.
- To study the Dual Tone Multi Frequency (DTMF) tones generator theory.
- To design the DTMF tones generator using software and C++ language.
- To implement the DTMF tones generator in alarm system that able to make a call to a specific number using PIC Microcontroller and corresponding circuit.

1.3 Problem Statements and significance of the project

Nowadays, the only bell alarm system is not sufficient since once the intruders the house, they can easily cut-off the system before the owners realize about that. So that, an alarm system that can immediately tell the owner is needed and it is very crucial for every house to have one.

There are current existing systems that serve this objective, but due to the price not all people can have this at their home. The system of this project is cheap and easy to install since it only will be attached to the telephone that already have at home.

CHAPTER 2

LITERATURE REVIEW AND THEORY

2.1 Burglar Alarm System.

Alarm system is a device that signals the occurrence of some undesirable event. Burglar or intrusion alarm is an electrical house alarm designed to alert the owner to any danger. The simplest type of burglar alarm control consists of a single relay. In this type, the sensor circuit (called the loop in industrial terminology) holds the relay energized. Since the path for the loop goes through a set of contacts which are normally open (when the relay is restored they are open, when the relay is energized they are closed), when the loop opens, even momentarily, the relay will drop out and stay that way. A second set of contacts on the relay, normally closed is used to operate the annunciator, usually a bell. The system is disarmed by a key-operated shunt which forces the relay to energize, and is armed by closing all traps and then by opening the shunt. While burglar alarm controls are now very elaborate, the single-relay control incorporates all the functionality of any control. These controls and a closely related dual-relay design are still widely used in stand-alone applications, powered by lead-acid batteries [4].

Modern alarm controls are solid-state devices, and do not use the relays that the older alarm panels used to go into alarm. They make use of relays to modulate the alarm notification device as needed. And they use a relay to seize the telephone line to communicate to the monitoring station. Most switching devices are N.C. (normally

closed) circuits, so when the device is not in an alarm condition, the circuit is closed. Most alarm circuits (zones) are also set up to open or close on reading a certain resistance, usually between 1K and 5K ohms when inactive and double the value when active. This wiring system is called dual loop and allows for both alarm and anti-tamper detections to be incorporated into one circuit (anti-tamper occurs when the resistance level moves outside normal open/close values). This is the standard circuit in most modern systems [4].

Burglar (or intrusion), fire, and safety alarms Sensors are connected to a control unit via a low-voltage hardwire or narrowband RF signal which is used to interact with a response device. The most common security sensors indicate the opening of a door or window or detect motion via passive infrared (PIR). New construction systems are predominately hardwired for economy. Retrofit installations often use wireless systems for a more economical and quicker install. Some systems serve a single purpose of burglary or fire protection. Combination systems provide both fire and intrusion protection. Sophistication ranges from small, self-contained noisemakers, to complicated, multi-zoned systems with color-coded computer monitor outputs. Many of these concepts also apply to portable alarms for protecting cars, trucks or other vehicles and their contents [3].

2.2 Dual Tone Multiple Frequency (DTMF) Generation

DTMF is associated with digital telephony, and provides two selected output frequencies (one high band, one low band) for a duration of 100 ms. DTMF generation consists of selecting and combining two audio tone frequencies associated with the rows (low band frequency) and columns (high band frequency) of a pushbutton touch tone telephone keypad. The low band frequencies are 697 Hz, 770 Hz, 852 Hz, and 941 Hz, while the high band frequencies are 1209 Hz, 1336 Hz, 1477 Hz, and 1633 Hz [1]. The matrix for selecting the high and low band frequencies associated with each key is shown in Figure 2.1.

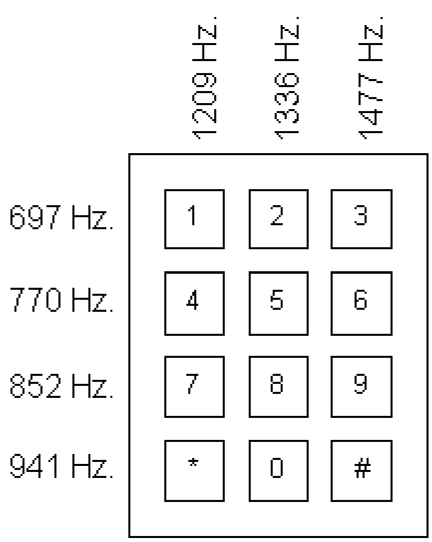


Fig 2.1 The DTMF frequencies and corresponding keys

Each key is uniquely referenced by selecting one of the four low band frequencies associated with the matrix rows, coupled with selecting one of the four high band frequencies associated with the matrix columns. The DTMF keyboard input decode

subroutine assumes that the keyboard is encoded in a low true row/column format, where the keyboard is stroked sequentially with four low true column selects with each returning a low true row select. The low true column and row selects are encoded in the upper and lower nibbles respectively of the accumulator, which serves as the input to the DTMF keyboard input decode subroutine. The subroutine will then generate the DTMF hexadecimal digit associated with the DTMF keyboard input digit [1]. For example, in order to generate the DTMF tone for "1", a pure 697 Hz signal will be mixed with a pure 1209 Hz signal (see Fig 2.2) and so on.

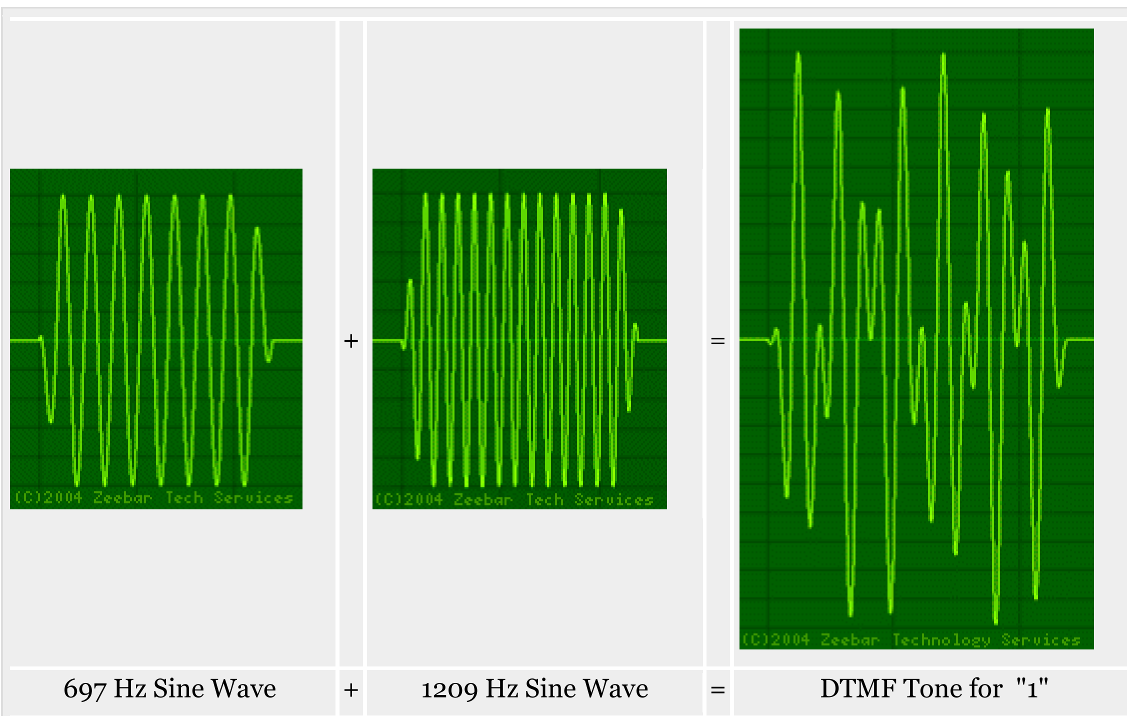


Fig 2.2 Two Pure Sine Waves combine to form the DTMF Tone for "1" from [2]

CHAPTER 3

HARDWARE DESIGN

3.1 System Design

In conventional home telephone system, the DTMF tones will be generated according to the keypad pressing. The system or circuit in the telephone will recognize the pressing of the keypad button and generate the different DTMF tones. The combination of tones according to any phone number when go through the fix phone line will replace a call to that number.

In this project, the same concept will be used in order to make a call except a new automatic system will be used for the tones generation instead of the keypad (and its system). The overall system design of the project and its components are shown in the figure 3.1.

The project is based on the PIC Microcontroller in order to generate the DTMF tones. Accompanied by the R-2R Ladder Network as the Digital to Analog Converter (DAC) and certain software (will be discussed in chapter four), the DTMF tones will be generated when any switches is triggered. The output and ground pins of the DAC will be connected to the speaker of the handset as shown in Fig 3.2. In addition, a bell or lamp can be added in the system to give an alarm signal if there any intrusion.

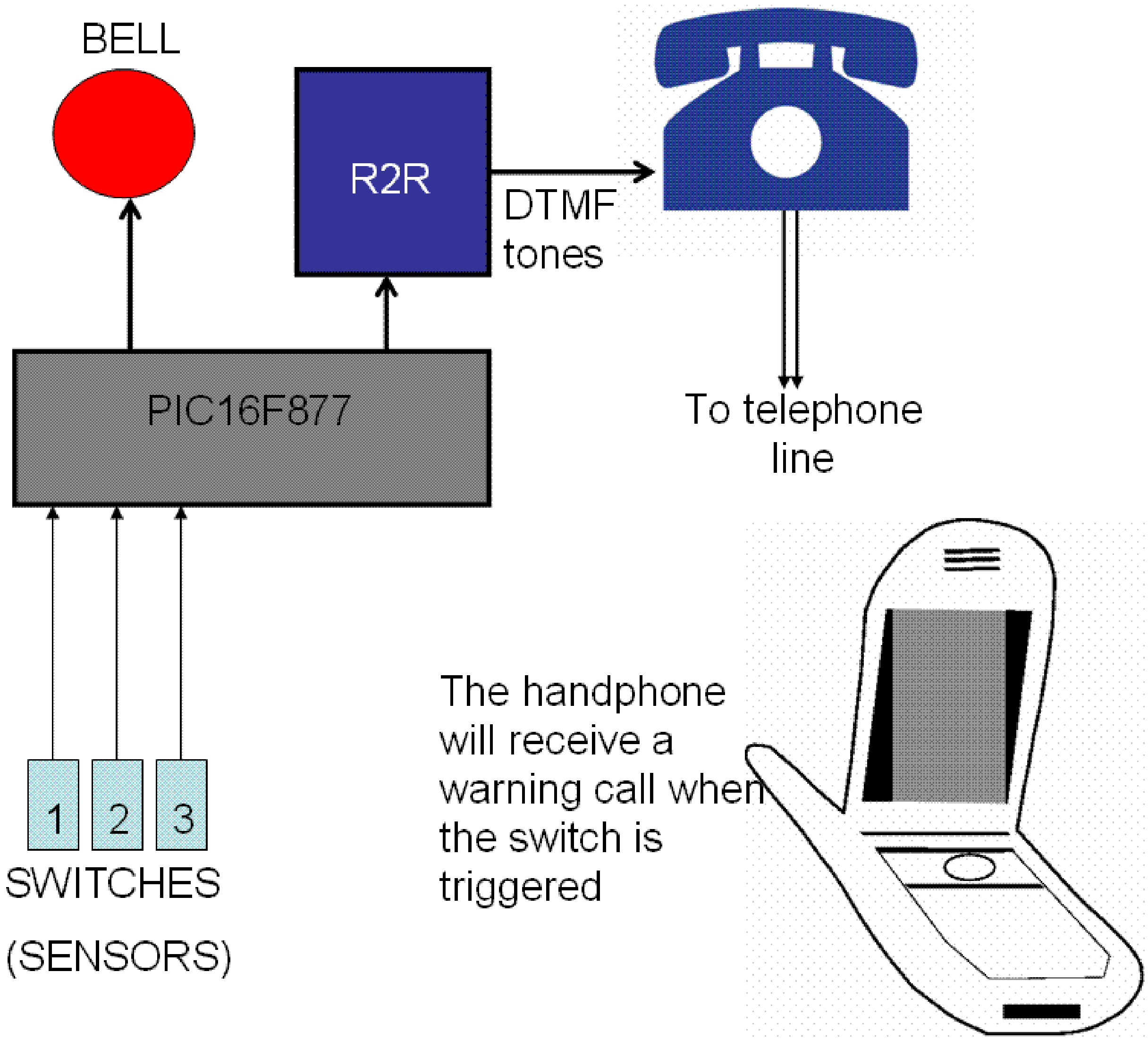
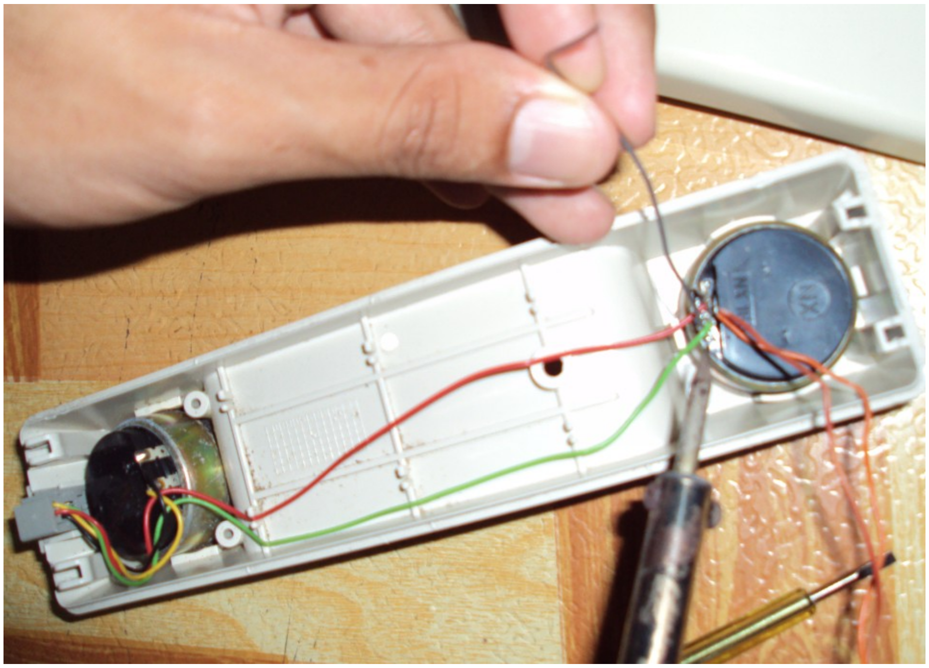


Fig 3.1 Block diagram of overall system design



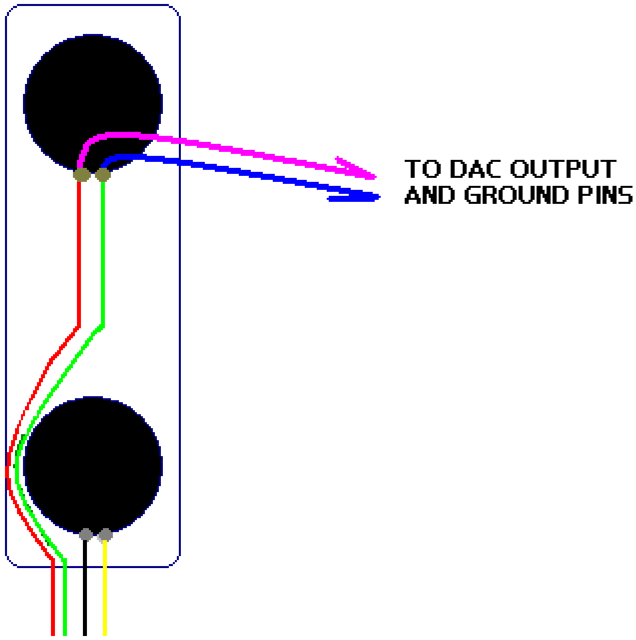


Fig 3.2 The connection of the DAC pins the telephone.

3.2 Components Selection

3.2.1 PIC 16F877A Microcontroller

PIC 16F877 (Microchip Technology, Inc.) 8-bit microcontroller will be used for the controller. It was chosen to detect any switch triggered and generate the DTMF tones according to the predetermined handphone number. This microcontroller has a 25 MHz processor (the current compiler runs the processor at 20 MHz), 33 input/output (I/O) pins, (8K*14words) of Enhanced FLASH program memory, (368*8bytes) of RAM, (256*8bytes) of data EEPROM. The PIC does not have an operating system and simply runs the program in its memory when it is turned on.

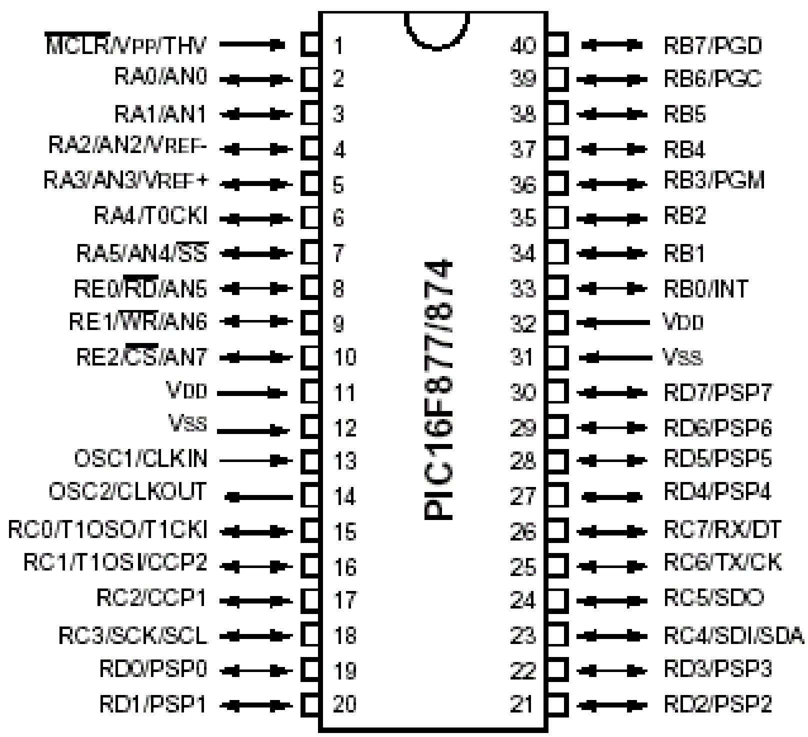


Fig 3.2 PIC Microcontroller

3.2.2 R-2R resistor ladder network

A basic R-2R resistor ladder network is shown in Figure 3.2 is a circuit that used to convert the digital signal to analog signal. In this project the circuit is used to generate the DTMF according to the digital input from the PIC Microcontroller. The digital inputs of the circuit range from the most significant bit (MSB) to the least significant bit (LSB) and the bits are switched between either 0V or 5V. All the inputs are connected to the port D of PIC from D1 until D7. The MSB will cause the greatest change in output voltage and the LSB cause the smallest. The R-2R ladder is cheap and easy to manufacture since only two resistor values are required which are 100 Ω and 200 Ω. The GROUND and the OUTPUT pins will be connected to the telephone circuit to produce the DTMF tones.

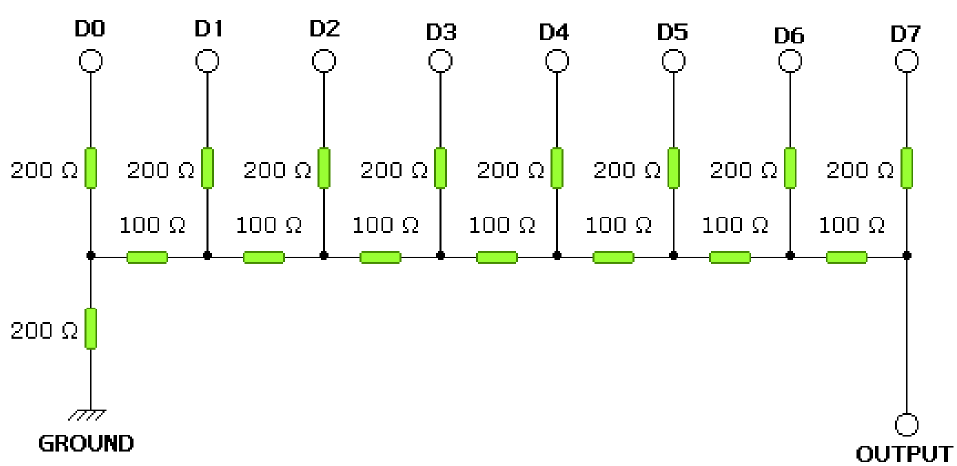


Fig 3.3 The R-2R Ladder Network

CHAPTER 4

SOFTWARE DESIGN

4.1 System Design

Figure 4.1 shows the flowchart of the whole programming structure of the alarm system. The only sensor used is the simple switch that normally opened (NO), which means it will be off at all time unless it is triggered. However, that sensor can be replaced by motion sensor or other suitable one.

Once the sensor detects any intrusion due to the opening of a window or detection of motion, the PIC Microcontroller accompanied by a related electronic circuit will generate the DTMF tones according to a preset handphone number. That generated tones will be sent to the home telephone circuit and will replace a call to that handphone.

At the same time, the microcontroller will on the bell alarm to give a signal to the people around that area. The software that used in this project will be discussed in the next part and the whole programming coding will be attached at the appendix.

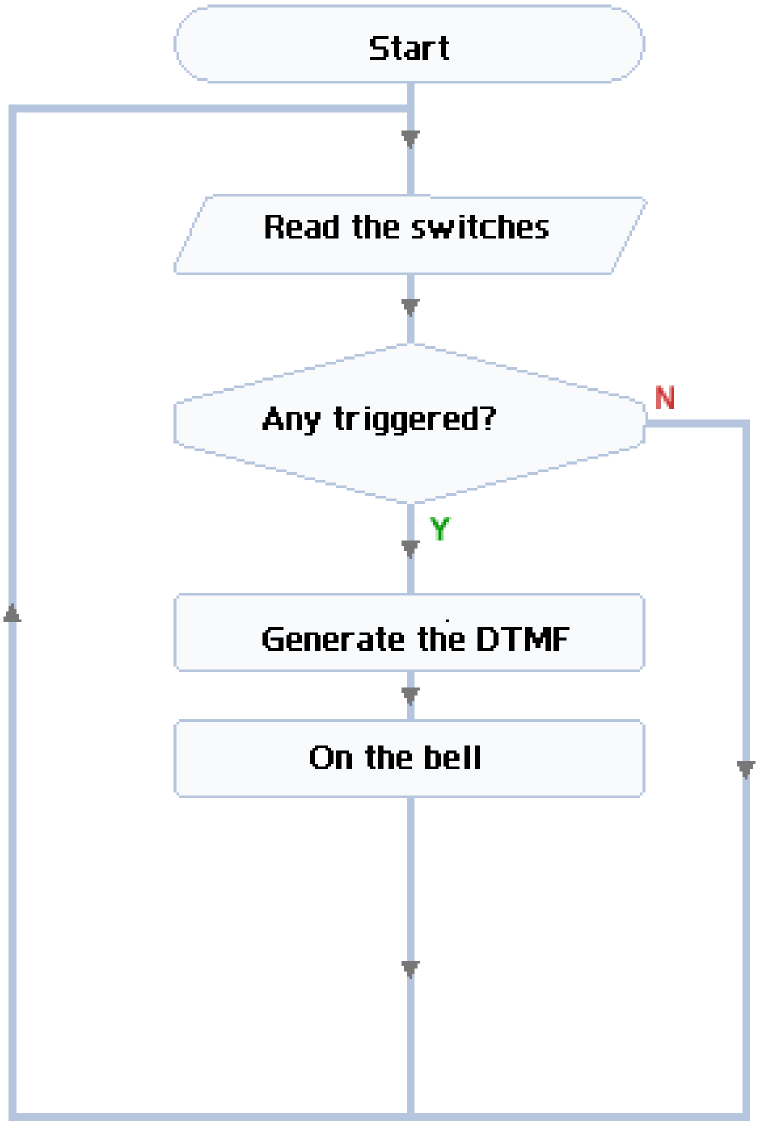


Fig 4.1 The flowchart of the whole project

4.2 Software Used

4.2.1 PCW C Compiler

This software is being used to design and write the programming code of the project in C++ language. The code then will be compiled to generate the .hex file to be burn into the PIC Microcontroller. One of the advantages of this compiler is to provide higher level programming for designer to solve their problem faster and more efficient.

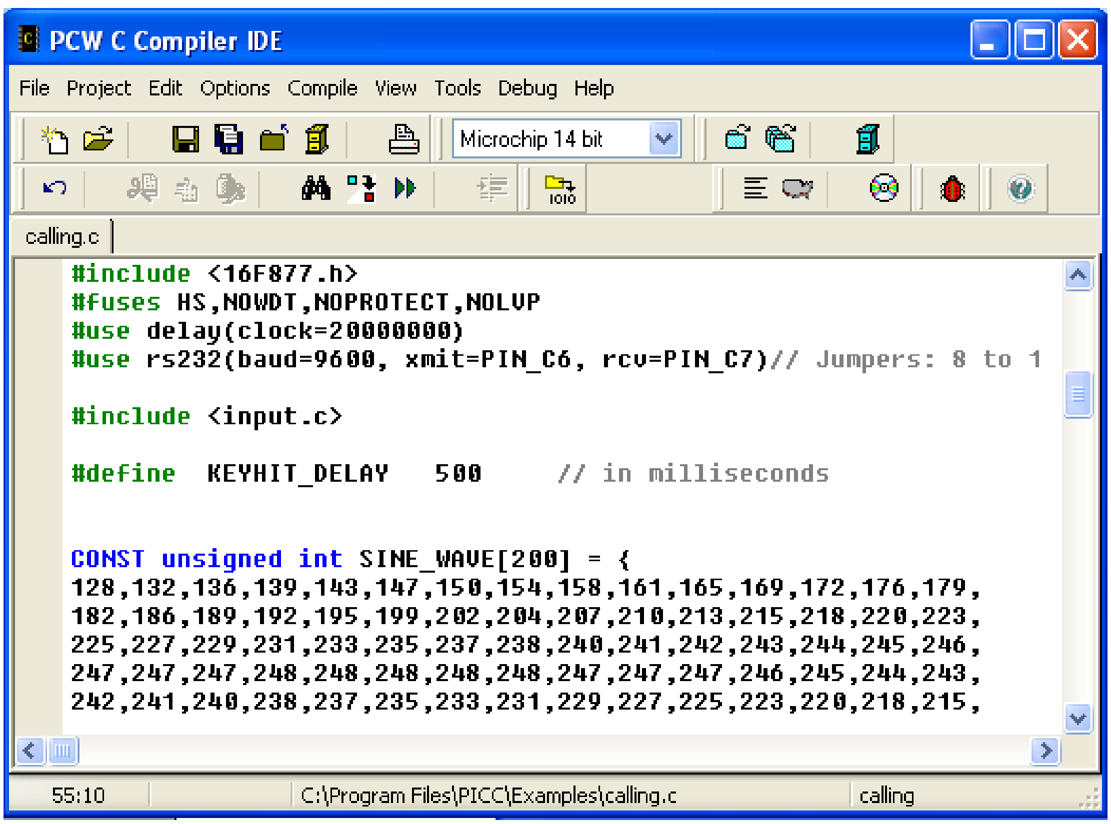


Fig 4.2 The PCW C Compiler

4.2.2 PIC Bootloader +

This software is being used to download the .hex file of the source code into PIC Microcontroller. It also has a window to display the output of the code.

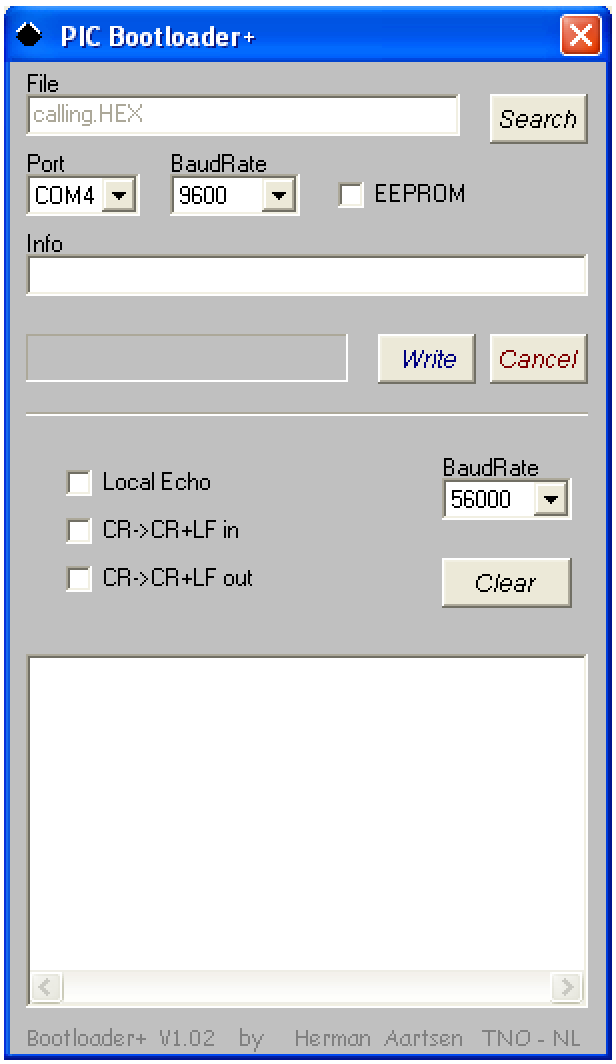


Fig 4.3 The PIC Bootloader+

CHAPTER 5

CONCLUSION

In conclusion, it can be claimed that the project of To Handphone Burglar Alarm provide benefits in improving the current alarm system. By only 9V battery, low-cost PIC Microcontroller and other circuit, this alarm can be applied at any houses, offices or shops as long as they have the fix phone line. The cost and size of this project can be reduced by:

1) Use cheaper PIC that have less pins (18 pins), for example PIC 16F83.
2) Design the PCB (printed circuit board) of the PIC and the corresponding circuit in the smallest way.

Hopefully, this project can be a great deal for me since I'm doing my EIT at Telekom Malaysia and working under an experience person. Here, I would like to suggest that this project can be further continued as final year project (FYP) for IIUM students.

REFERENCES

[1] National Semiconductor, Application Note 666, Verne H. Wilson, June 1990.

[2] http://www.dialabc.com/sound/dtmf.html; June 2009.

[3] http://en.wikipedia.org/wiki/Burglar_alarm; June 2009.

[4] http://en.wikipedia.org/wiki/; June 2009.

[5] CCS Inc.

APPENDIX A

FINISHED PRODUCT

APPENDIX B

PROGRAMMING FOR PIC MICROCONTROLLER [5]

```
#include <16F877.h>
#fuses HS,NOWDT,NOPROTECT,NOLVP
#use delay(clock=20000000)
#use rs232(baud=9600, xmit=PIN_C6, rcv=PIN_C7)// Jumpers: 8 to 11, 7 to 12


CONST unsigned int SINE_WAVE[200] = {
128,132,136,139,143,147,150,154,158,161,165,169,172,176,179,
182,186,189,192,195,199,202,204,207,210,213,215,218,220,223,
225,227,229,231,233,235,237,238,240,241,242,243,244,245,246,
247,247,247,248,248,248,248,248,247,247,247,246,245,244,243,
242,241,240,238,237,235,233,231,229,227,225,223,220,218,215,
213,210,207,204,202,199,195,192,189,186,182,179,176,172,169,
165,161,158,154,150,147,143,139,136,132,128,124,120,117,113,
109,106,102, 98, 95, 91, 87, 84, 80, 77, 74, 70, 67, 64, 61,
 57, 54, 52, 49, 46, 43, 41, 38, 36, 33, 31, 29, 27, 25, 23,
 21, 19, 18, 16, 15, 14, 13, 12, 11, 10,  9,  9,  9,  8,  8,
  8,  8,  8,  9,  9,  9, 10, 11, 12, 13, 14, 15, 16, 18, 19,
 21, 23, 25, 27, 29, 31, 33, 36, 38, 41, 43, 46, 49, 52, 54,
 57, 61, 64, 67, 70, 74, 77, 80, 84, 87, 91, 95, 98,102,106,
109,113,117,120,124};

int index1,index2,inc1,inc2;


#INT_RTCC
void wave_generator()
{
  int wave = 0;

  set_rtcc(25);          // when clock is 20MHz, interrupts every 100us

  wave = ((long)SINE_WAVE[index1]+(long)SINE_WAVE[index2])/2;
  output_d(wave);

  index1 += inc1;
  index2 += inc2;

  if(index1 >= 200)
    index1 -= 200;

  if(index2 >= 200)
    index2 -= 200;
}
```

```
#define DTMF_ROW1   14  // for 700 Hz, increment this many times every 100us
#define DTMF_ROW2   15  // for 750 Hz, increment this many times every 100us
#define DTMF_ROW3   17  // for 850 Hz, increment this many times every 100us
#define DTMF_ROW4   19  // for 950 Hz, increment this many times every 100us
#define DTMF_COLA   24  // for 1200 Hz, increment this many times every 100us
#define DTMF_COLB   27  // for 1350 Hz, increment this many times every 100us
#define DTMF_COLC   30  // for 1500 Hz, increment this many times every 100us

void generate_dtmf_tone(char keypad, long duration)
{

  index1=0;
  index2=0;
  inc1=0;
  inc2=0;
  if((keypad=='1')||(keypad=='2')||(keypad=='3'))
    inc1=DTMF_ROW1;
  else if((keypad=='4')||(keypad=='5')||(keypad=='6'))
    inc1=DTMF_ROW2;
  else if((keypad=='7')||(keypad=='8')||(keypad=='9'))
    inc1=DTMF_ROW3;
  else if((keypad=='*')||(keypad=='0')||(keypad=='#'))
    inc1=DTMF_ROW4;

  if((keypad=='1')||(keypad=='4')||(keypad=='7')||(keypad=='*'))
    inc2=DTMF_COLA;
  else if((keypad=='2')||(keypad=='5')||(keypad=='8')||(keypad=='0'))
    inc2=DTMF_COLB;
  else if((keypad=='3')||(keypad=='6')||(keypad=='9')||(keypad=='#'))
    inc2=DTMF_COLC;

  setup_counters(RTCC_INTERNAL,RTCC_DIV_2);
  enable_interrupts(INT_RTCC);
  enable_interrupts(GLOBAL);

  while(duration-- > 0)
  {
    delay_ms(1);
  }
  disable_interrupts(INT_RTCC);
  output_d(0);
}
```

```
void main()
{
  //char k[10]={0,1,3,3,3,4,2,5,4,7};
  char k[10]={48,49,51,51,51,52,50,53,52,55};
  int i;

    for ( i=0;i<10;i++)
    {

        printf("%c",k[i]);

        if(k[i]!=0)
          generate_dtmf_tone(k[i], 100);
          delay_ms(100);
    }

}
```